HEWLETT PACKARD

IAM-91563 RFIC Downconverter Demonstration Board

Assembly and Operation for 1.9 GHz

IAM-91-A

Description

The IAM-91-A demonstration circuit allows you to test and evaluate the performance of the IAM-91563 RFIC downconverter for use in your specific wireless system. While this circuit board is designed to operate for RF bands from 800 MHz to 6 GHz, this document specifically addresses 1.9 GHz applications.

The IAM-91-A printed circuit board is made on 0.031-inch thick FR-4 dielectric material and accommodates a SOT-363 (SC-70) surface mount package.

Refer to the *Applications Section* of the IAM-91563 Data Sheet for a detailed description of how to design with the IAM-91563.

A schematic diagram of the evaluation circuit is shown in Figure 1.

At the RF input to the IAM-91563, the series capacitor, C1, and shunt transmission line, MLIN 1, provide three functions. The first is to match the input impedance of the IAM-91563 to 50 Ω. Second, the series C - shunt L topology forms a high pass filter that helps eliminate interference from the mixer's image frequency. And, third, the series capacitor blocks DC from the stage preceding the mixer.

At the IF output, capacitor C2 and inductor L1 form a low pass filter network that serves the dual purpose of matching the IF output to 50 Ω and of filtering RF and LO signals from the IF.

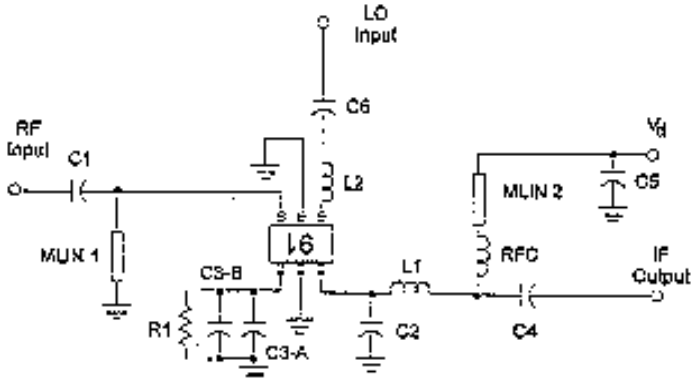

Figure 1. Schematic Diagram

The supply voltage of the IAM-91563 is applied to the IF output pin by means of a bias decoupling network consisting of the RF choke, RFC, bypass capacitor, C5, and length of line, MLIN 2. The IAM-91-A PCB differs slightly from the board layout shown in the IAM-91563 data sheet in that the bias supply is bypassed to ground at the end of transmission line MLIN 2 instead of immediately after the RFC as in the data sheet. MLIN 2 is not a required element for this circuit. Capacitor C4 is a DC blocking capacitor for the IF output.

As noted in the data sheet, the impedance of the LO port is already close to 50 Ω and does not necessarily require impedance matching. If, however, LO power is at a premium, inductor L2 can be used to further match the LO port.

The table below summarizes component values for the downconverter design with a RF of 1.9 GHz and IF of 100 MHz.

Component	Value
C1	0.5 pF
C2	2 pF
C3-A, C6, C5	100 pF
C3-B	1000 pF
C4	800 pF
L1	100 nH
L2	8.2 nH
MLIN 1	Z_0=90 Ω l = 0.40 in.
MLIN 2	not critical
RFC	820 nH

Final component values may differ slightly due to effects such as parasitics in the particular components that are used, e.g., the series inductance in C1. A CAD program such as HP Touchstone® may be used to fully analyze and account for these variables.

Assembly

The mixer and related components are assembled onto the printed circuit board as shown in Figure 2.

The layout is designed to use edge-mounting SMA connectors such as the EF Johnson 142-0701-851. The connectors slip over the edge of the board without the need for drilling holes. The center conductors are soldered to the RF, LO, and IF microstrip lines and the ground pins of the connectors are soldered to the ground plane on the backside of the board and to the ground pads on the topside.

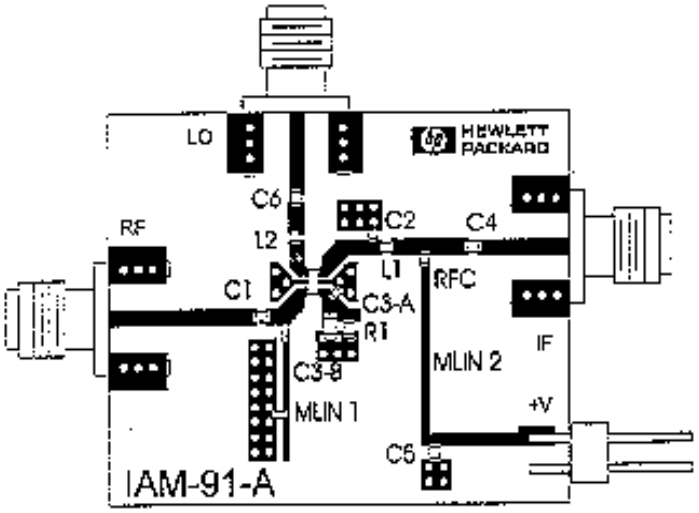

Figure 2. Assembled Circuit

A small metal tab is used to connect the RF input pad of the IAM-91563 (near C1) to the upper end of MLIN 1. A metal tab is also soldered between MLIN 1 and the large ground pad in the approximate position shown in Figure 2. It may be desirable to add this tab later while observing the RF input match.

The Source Bypass pin must be bypassed to ground at both the RF/LO and the IF as shown in the detail drawing in Figure 3. It may be desirable to use two capacitors for this purpose.

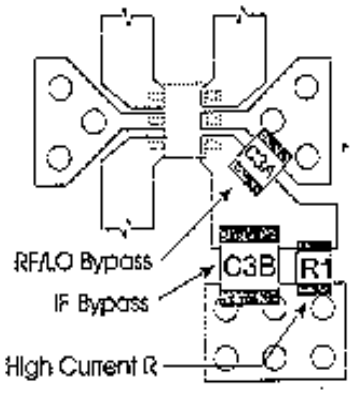

Figure 3. Source Bypass

A smaller value capacitor used to bypass the RF/LO (C3-A) should be located very close the pin as shown in the drawing. This capacitor should be of a higher quality type suitable for bypassing frequencies in the RF/LO range. The ground pad at the bottom of Figure 3 may then be used for a larger value capacitor (C3-B) to bypass the IF.

When biased in the High Linearity Mode, this ground pad is also used for the resistor, R1, that is added from the Source Bypass pin to ground.

The +V and adjacent ground pads are designed to fit a 2-pin, 0.100" centerline flat header of the type popularly used on computer PC boards (e.g., Waldom-Molex 4030 series). This inexpensive type of connector provides a convenient means of making connections to the power supply.

Operation & Tuning

The IAM-91563 is voltage biased device. To operate, it is only necessary to apply +3 volts to the +V connection. Typical current drain is 9 mA in the normal mode of operation.

As a first step in checking or optimizing the tuning of the circuit, the return loss of the RF input port could be observed with a swept scalar network analyzer. The optimum position of the shorting tab on MLIN 1 may then be easily determined.

The impedance matches for the IF output and LO input ports can be checked in a similar manner.

To use the High Linearity Mode feature, a resistor is added from the Source Bypass pin to ground as shown in Figure 3. The use of this resistor increases the device current with a resulting increase in mixer linearity (IP_3) and output power (P_{1dB}).

The use of a 15 Ω resistor at the Source Bypass pin, for example, increases the device current from a nominal 9 mA to 14 mA. This increases the input IP_3 by approximately 3.5 dB. Refer to the IAM-91563 data sheet for more information about the High Linearity Mode of operation.

Note: Actual performance of downconverters mounted on the demonstration board may not precisely match the data shown in the data sheet. The board material, passive components, and connectors all introduce losses and parasitics that may alter the actual operating characteristics of the IC, especially at higher frequencies.